

# Economic efficiency of environmental management system operation in industrial companies

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**Abstract.** The article examines the issue of the efficiency of the environmental management system (EMS) implementation in the Russian machine-building companies. The analysis showed that Russia clearly lags behind other developed and developing countries in terms of the number of ISO 14001 certified companies. According to the authors, the main cause of weak system implementation activity is attributed to the lack of interest in ISO 14001 certification on the Russian market. Five-year primary (field) research aimed at the analysis of the environmental priorities of the civilians suggests that the image component of the economic benefits ensures the increase in economic and financial performance of the company due to the increase in customers' loyalty to the products of the EMS adopter. To quantify economic benefits obtained from EMS implementation, a methodological approach with regard to the image component and the decrease in semi-fixed costs due to the increase in the production scale has been developed. This approach has been tested in a machine-building electrical equipment manufacturer in Ekaterinburg. This approach applied to data processing yields the conclusion that EMS gives a good additional competitive advantage to its adopters.

## 1. Introduction

Environmental safety issues have recently been more extensively addressed in the Russian Federation than in the past. Environmental management strategy is part of federal (for the period of 2008–2020) and regional social and economic programs, Russian Federation environmental safety strategy (for the period of 2016–2025), and state environmental stewardship program (for the period of 2012–2020). Russian government aims to reduce emissions by 2.2 times by 2020 compared to 2007, to reduce the number of the cities/towns with high level of air pollution by 2.7 times, and to increase the share of utilized and neutralized waste products and consumption of danger class I–IV wastes in the total amount of wastes by 2.2 times. To attract wide public attention to this issue, in Russia the year 2017 has been declared the Year of Ecology.



The situation is exacerbated by the fact that many large companies in Russia are located within the residential areas due to urbanization, including megalopolises, or such companies are historically town-forming, which means that the cities/towns started their development around such companies (the majority of the Ural towns have been developed according to this principle). Green production will significantly improve the living conditions of the population. EMS implementation is one of the tools that enable achieving this.

As European experience demonstrates, EMS implementation increases economic competitive ability of a company and, thus, its profitability [1–3]. The question is whether this is possible in Russia and its specific conditions?

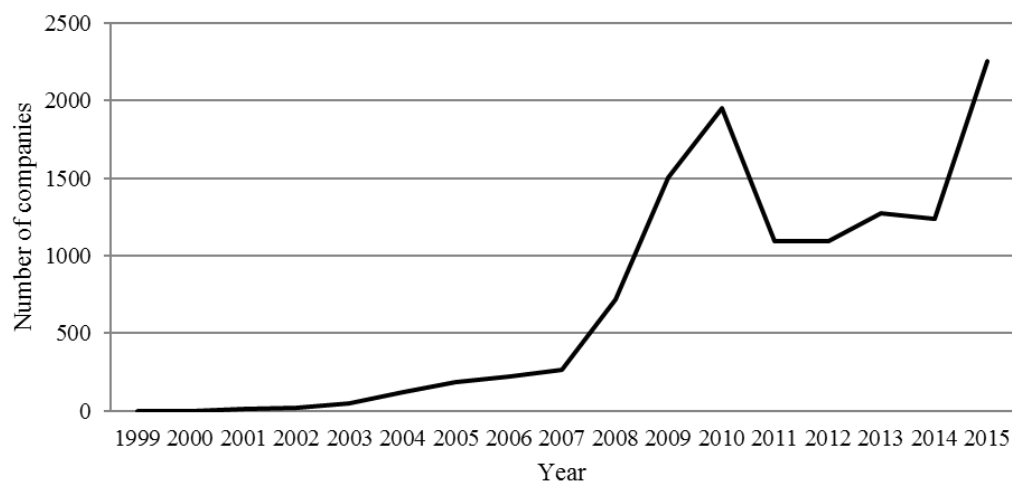
## 2. Analysis of EMS (ISO 14001) implementation in the Russian Federation

EMS was first implemented in Russia in 1998 (Figure 1). The trail-blazers were some companies operating in mining, processing and metallurgical industries (*GAZPROM* (OAO), *Oil Company Lukoil* (OAO), *NLMK Lipetsk* (OAO), *TMK* (OAO), etc.). Some other chemical and machine-building companies like *Nornickel* (OAO), *Silvinit* (OAO, now part of *Uralkali* (OAO), etc. joined this process in 2005. The very first company in Sverdlovskaya Oblast implemented EMS was *Nizhny Tagil Metallurgical Plant* (OAO), followed by the companies belonging to *UGMK-Holding* (*Ural Mining Metallurgical Company*). The system was introduced in the machine-building companies in Sverdlovskaya Oblast in 2007.

The number of certified companies gradually increased but within the period from 2011 to 2015 there was a decline observed, as due to unstable economic conditions some companies withdrew from the market, while others preferred not to develop EMS (Figure 1).

The main reasons for EMS implementation in the above mentioned companies were external requirements, first of all, the necessity to obtain mandatory environmental management certificates of conformity to be able to operate abroad. If no such a certificate is available, then the goods are not allowed to enter the European market or can be sold only at much cheaper prices. The companies selling their goods in Russia and the neighboring countries do not face such strict requirements for EMS implementation from their partners and buyers.

Therefore, Russia occupies one of the last places in number of the ISO 14001 certified companies.



**Figure 1.** Number of Russian companies obtained the certificate

The main cause of weak system implementation activity in Russian companies is the lack of economic interest. State environmental governance in Russia still depends on administrative methods.

According to the sustainable development principle, there are three major concerns that effect evaluation of economic efficiency of the activities (including the sphere of environmental stewardship), i.e. social, environmental and economic concerns. Economic benefits from implementation of environmental activities in Russia are mainly achieved due to reduction of prime costs through lower environmental pollution payments and due to profit improvement through an increase in prices for the goods. Fluctuations in the sales volumes are not normally associated with environmental activities as they are attributed to competition and changes in the market.

The analysis of changes in external economic management of Russian industrial companies shows that nowadays, in conditions of an increased environmental awareness of the consumers and strong influence of non-governmental environmental organizations, competitive recovery through *green* reputation has a significant motivation impact on top management of the companies.

### 3. Methodological approach to definition of EMS implementation

The most widespread approach to evaluate economic efficiency of EMS implementation in the companies is strengthening of their business reputation that leads to the increase in cost of intangible assets defined through goodwill [4–6]. We define economic efficiency in a wider sense of the word, not only through business reputation of the company, but also through its image.

Image, reputation and brand are three notions, very similar with respect to their meaning, therefore it is important to understand the difference and interrelation between them. To form a brand and reputation it is necessary to promote a favorable image, which requires certain efforts from the company. Reputation is based on the created image and is developed due to interaction of target audience and the company. Brand is formed on the basis of a positive image and reputation and is consumer-oriented. If a company wants to be competitive on the market, these notions must become fundamental for it [7, 8].

We agree with the specialists who believe that image is a crucial success factor in different business spheres. It is created due to stable activity of the company, its reliability and honesty in financial relations with the partners.

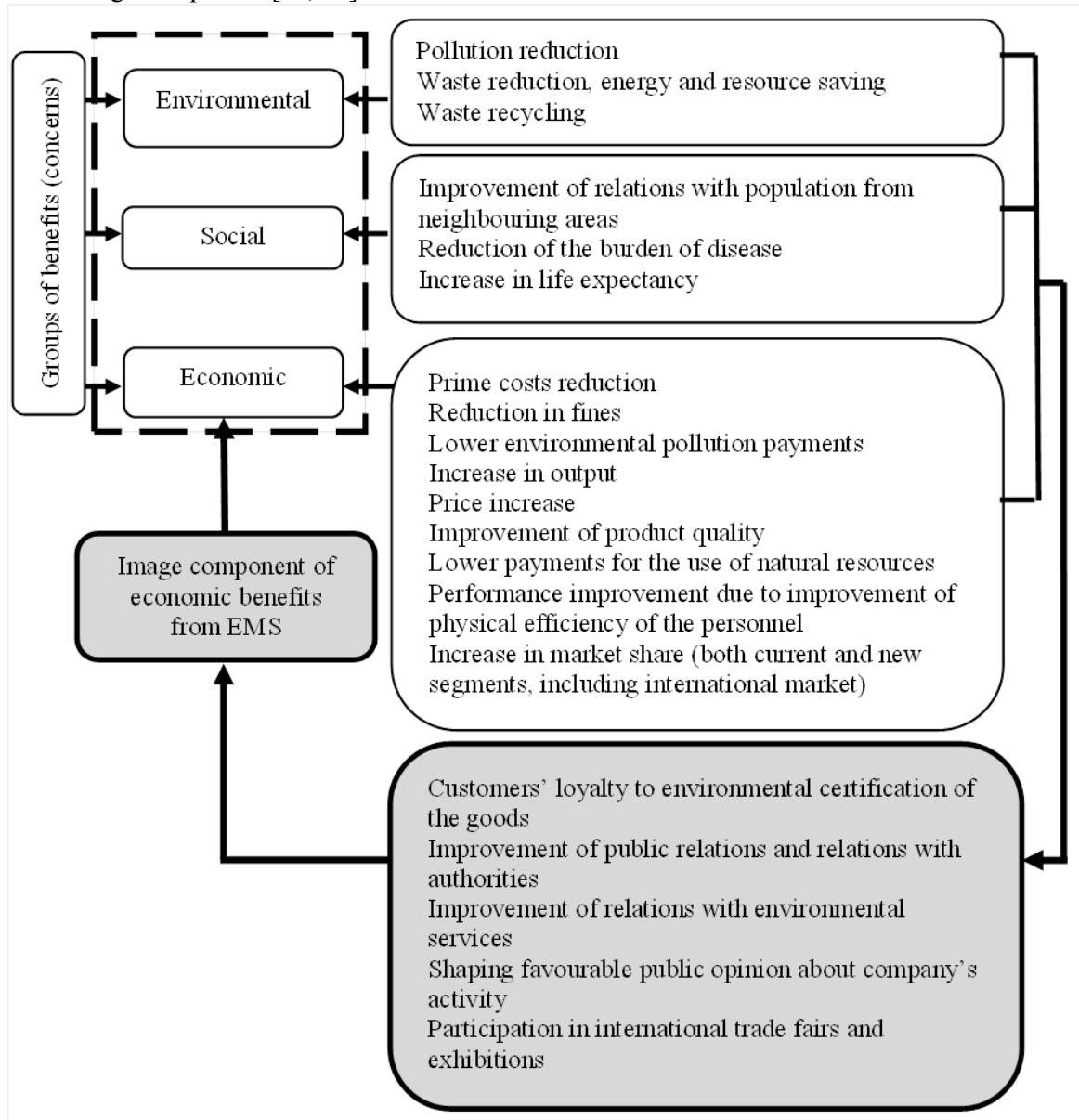
To improve the image, it is necessary to determine what result we want to get: to increase sales, to enter a new market sector, to attract investors, etc. Nowadays, environmental and social policies of the company also influence its image (for example, implementation of the Quality Management System, EMS, etc.). The choice determines target audience (consumers, bodies of power, environmental departments, etc.) with its specific targets and objectives for quick achievement of the desired image.

The analysis of EMS implementation yielded the entire block of information that is usually not taken into consideration when dealing with conventional economic benefits (Figure 2). As a result, we have formed a proposition that image is involved in economic benefits. It ensures enhancement of economic and financial performance of the company due to increase in customers' loyalty to the products of the EMS adopter. We believe that image component of economic benefits is the indicator that allows assessing economic efficiency of EMS implementation to the fullest extent possible.

To prove our hypothesis, we have carried out primary (field) research aimed at the analysis of environmental benefits and priorities based on random sample of respondents (more than 300 people). The survey showed gradual rise in environmental awareness among consumers.

To develop a practical framework for our suggestion, we have carried out the analysis of current Russian (such documents as *Economic Efficiency of Environmental Costs*, *Economic Efficiency of Environmental Activities*, *Efficiency of Environmental Entrepreneurship*, etc.) and foreign practices for evaluation of environmental and economic efficiency of business activity [5, 6, 9–11]. Available printed sources show that current approaches are based on capital cost recovery principle, reduction of environmental damage, improvement of business reputation, price increase, and improvement of production quality. Nevertheless, none of these approaches takes into account marginal income gained through EMS implementation. Thus, we have proposed a comprehensive framework for

evaluation of economic benefits through EMS implementation and operation with due regard to the image component [12, 13].



**Figure 2.** EMS implementation and its results

The obtained results show that the following components of the economic benefits can be identified with regard to EMS implementation.

Net profit fluctuation ( $\Delta P_n$ ) due to lower payments for excess pollution ( $\Delta P_{excess}$ ) and reduction of fines for adverse impact on the environment ( $\Delta F$ ) can be calculated as in equation (1):

$$\Delta P_n = \Delta P_{excess} + \Delta F \quad (1)$$

1. Prime cost fluctuation due to lower rated environmental pollution payments ( $\Delta C$ ).

In addition to existing indices, we recommend to calculate the sales gain and prime cost savings due to improvement of the company's image.

2. Marginal income gains from the increase in sales and production volumes and from the savings in semi-fixed production costs during EMS implementation ( $P_m$ ). In this case we assume that the production costs structure does not undergo any changes when EMS is operated, and additional costs for its implementation are expressed by a separate component. As the increase in sales volumes can be caused by both external (market environment) and internal factors (re-equipment, production modernization, advertising campaign, etc.), marginal income gains must be calculated with application of a correction coefficient  $a$ , that determines the influence of the company's image improvement on sales volumes.

Savings obtained from improvement of a company's image can be calculated as in equation (2):

$$P_m = (V - S_{var}) \cdot a \quad (2)$$

where  $V$  = sales volume, th.rubles/year,

$S_{var}$  = semi-variable costs for the total volume of products, th.rubles/year,

$a$  = influence coefficient taking into account image component of the economic benefits.

General formula for calculation of total savings from EMS implementation is as follows (3):

$$E_{EMS} = [(V - S_{var}) \cdot a - S_{EMS}] + (\Delta P_n + \Delta C) \quad (3)$$

where  $E_{EMS}$  = annual savings from EMS operation in a company, th.rubles/year,

$S_{EMS}$  = current costs for EMS operation, th.rubles/year.

Annual efficiency is calculated as follows (4):

$$E_{ann} = \frac{E_{EMS}}{C + E_H K} \quad (4)$$

where  $E_{ann}$  = annual efficiency from EMS operation, th.rubles/year,

$C$  = nonrecurrent costs for EMS implementation and operation, th.rubles/year,

$E_n$  = present value index,

$K$  = capital costs for EMS implementation and operation, th.rubles/year.

Crucial element of this approach is allowance for the  $a$  coefficient and its definition. The coefficient takes into consideration which part of increased volume of sales is determined by an environmental certificate. The coefficient can be quantified by different methods:

- Expert evaluation method.
- Analogue method.
- Method of regression and correlation analysis.

Our algorithm is based on the regression and correlation analysis. The advantage of such an approach is the possibility to quantify the influence coefficient following the results of the analysis of activities of a large number of companies. However, the obtained results are valid only under stable external conditions, which can be considered a disadvantage of this approach. To eliminate this disadvantage, we suggest that the influence coefficient be calculated for different time periods associated with changes introduced to legislation and changes in market environment.

To apply this approach, it is expedient to improve a reference data base of a company. Calculation of the  $a$  coefficient requires data bases covering sales volumes of the industry EMS adopters.

#### 4. Research results

To determine the  $a$  coefficient, we have carried out the regression and correlation analysis for five Russian machine-building companies within the period from 2005 to 2015. This allowed us to investigate the relationship between the indices under examination. This analysis was based on the reported data which can be freely consulted on the official sites of the machine-building companies.

The following linear relationship was used for the regression and correlation analysis (5):

$$y = ax_1 + bx_2 \quad (5)$$

where  $y$  = income index (export index) for the companies,

$x_1$  = ordinal year of certification or assurance of compliance with the existing certificate,

$x_2$  = indices of income (export) fluctuations in the industry,

$a, b$  = influence coefficients.

The environmental conformity certificates are issued and re-issued on a regular basis, once every 3–5 years, and since the companies assure compliance with such certificates in different periods of time, the values of  $x_1$  in the model range from 1 to 5.

Obtained relationships have been distributed over certain time periods. Within the period from 2005 to 2010, the machine-building companies of Sverdlovskaya Oblast only started to implement EMS, thus the expenses required for such implementation were not covered by the image component of EMS operation. The world economic crisis took place in 2009. It was one of the factors that deteriorated economic activity of the machine-building companies. The period from 2011 to 2013 turned out to be the most stable with regard to both economics and politics. Many companies assured compliance with environmental certificates, which in its turn had its impact on the influence coefficient and its value became positive. The next period, from 2014 to 2016, turned out to be quite difficult for the machine-building industry due to the national trend towards import substitution. The influence coefficient under such unstable conditions raised. It was caused by EMS operation as the consumers preferred the goods in compliance with the requirements of international standards.

The obtained results have been tested against the following criteria: multiple correlation coefficient, standard error, F-test, and Student's t-test, which proves their significance.

Our regression and correlation analysis showed that EMS gives a good additional competitive advantage to the companies operated in stable conditions, and the value of the image component reduces with the increase in number of the companies obtained such a certificate.

Economic efficiency from EMS implementation in the machine-building company in Ekaterinburg calculated on the basis of the approach taking into account the company's image is given in the Table.

**Table.** Calculation of savings and economic efficiency from EMS implementation in a machine-building company in Ekaterinburg

Year	Approach with regard to the image component		
	Savings from lower environmental pollution payments, $\Delta P_n + \Delta C$ , th.rubles/year	Marginal income gains from the increase in sales volumes, $E_{EMS}$ , th.rubles/year	Efficiency with regard to image component, $E_{ann}$ , rubles/rubles
2009	31.3	16,175	43.15
2010	3.6	18,137.6	25.29
2011	9.5	17,507.3	13.61
2012	31.6	17,338.3	16.71
2013	28	14,338.4	9.85
2014	13.2	54,227.2	47.80
2015	19.1	50,869.8	44.37

The calculations make it evident that our approach yields comprehensive results obtained due to EMS implementation. Application of such an approach will allow top management of a company to evaluate the activities required for EMS operation in a more comprehensive way with due regard to all necessary components.



## 5. Conclusion

1. Nowadays, with the lack of economic interest demonstrated by Russian industrial companies, the main incentive to obtain ISO 14001 certificates is their urge to enter foreign markets and develop relations with foreign partners.

2. We believe that a new component of the economic benefits should be identified and described, i.e. the company's image. This positively influences environmental and social benefits of the business activities of the companies and can lead to improvement of business reputation.

3. Implementation of ISO 14001 EMS allows regulating the impact of production process on the environment (which gradually leads to improvement of its quality), and is also cost-efficient for the company.

4. We have introduced a new approach for calculation of total savings and economic efficiency when EMS is implemented and operated. This approach takes into consideration the image component of economic benefits. This component allows recognizing revenue gains obtained through the increase in prices and production volumes. This has been proved during the analysis of the data obtained for the period from 2006 to 2015 for one of the machine-building companies in Ekaterinburg.

5. Our regression and correlation analysis showed that EMS gives a good additional competitive advantage to the companies operated in stable conditions, and that the value of the image component reduces with the increase in number of the companies obtained such a certificate.

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